ACUTE SURGICAL CONDITIONS OF THE ABDOMEN IN CHILDREN*

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THE acute abdominal conditions in childhood differ materially from those of adult life as regards type of lesion, diagnosis and treatment. We have made a study of these abdominal conditions as they have appeared on the Children's Surgical Service of Bellevue Hospital, to which are admitted children up to the age of thirteen. The lesions may be divided into obstructive lesions and inflammations.

Congenital obstructions of the gastrointestinal tract are about the first to be brought to the attention of the surgeon and those of the upper part are the best known. The most common of these is congenital pyloric stenosis which has to be differentiated from the various types of duodenal obstruction.

The symptoms of upper gastrointestinal obstruction are typical. Vomiting begins early and soon becomes projectile in type. There is great distention in the upper part of the abdomen to correspond to the dilated stomach. Peristaltic waves can be seen and the bowels do not move. Because the baby is unable to retain any feedings he rapidly becomes dehydrated and emaciated.

In congenital pyloric stenosis the obstruction is due to the hypertrophied pyloric muscle which is sufficiently large to make a tumor palpable through the abdominal wall. The obstruction is not complete at first and does not become so until spasm develops in the pylorus. This happens usually about two weeks after birth, but may be earlier or later.

Duodenal obstruction may be of two types. The first is intrinsic due to a failure of the duodenal lumen to open properly and it may be a complete atresia from a plug of cells or from a diaphragm; or it may be a stenosis with a tiny lumen. The second is extrinsic and is associated with incomplete rotation of the gut producing obstructive bands or volvulus.

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The difference in pathology will establish the differential diagnosis between the upper abdominal obstructions. The vomiting of pyloric stenosis usually does not begin until after the second week of life, i.e., when the pylorus closes, although one of our patients developed symptoms on the day after his birth and another on the third day. The vomitus consists entirely of gastric contents as the obstruction prevents any regurgitation of duodenal contents such as bile. The pyloric tumor can be palpated, a sign pathognomonic of the condition and one which should always be found before operating.

When the obstruction is in the duodenum, vomiting begins shortly after birth and if the obstruction is distal to the papilla of Vater, which is the case in the majority of instances, the vomitus will contain bile. No firm tumor can be felt. If the meconium is examined, squamous epithelium will not be found as that which is characteristically present in meconium arises above the obstruction.

X-ray will help in the diagnosis as the gas-filled stomach will show on a flat film when the obstruction is pyloric, while the duodenum will be seen as well when the obstruction is duodenal. Contrast medium such as barium should not be employed as it may obstruct the stoma should anastomosis prove necessary.

Pyloric stenosis predominates in males in the ratio of 5 to 1 and shows a distinct familial tendency. Duodenal anomalies are apt to be associated with congenital anomalies elsewhere.

Pylorospasm occurs in early infancy and may resemble obstruction. It is not as severe as obstruction; it is intermittent and it can be relieved by atropine and thick feedings. The tumor pathognomonic of pyloric stenosis cannot be palpated.

Congenital obstructions of ileum or jejunum have much the same etiology as those of the duodenum and are decidedly rare. The vomiting commences a little later than in duodenal obstruction and the distention is much more extensive, involving more than just the upper abdomen.

Surgery is the treatment of all these organic obstructions and it should be undertaken at the earliest moment compatible with safety. To operate on an emaciated, dehydrated baby with a distended stomach is to court disaster. The fluid and electrolyte balance should be brought to normal and transfusion given if necessary. The stomach should be emptied by lavage before operation. It may require 2 or 3 days to get the baby in condition to undergo operation but it is time well-spent.

For anesthesia we prefer drop ether unless there is some contraindication. In that case we use local anesthetic of 0.5 per cent procaine. We employ an upper right rectus incision sufficiently high to overlie the liver. Robertson[1] has recently advocated a right subcostal incision which appears to have some advantages.

The operation for pyloric stenosis is the Fredet-Ramstedt procedure introduced into this country by Downes[2] and ably described by Donovan,[3] Robertson[1] and others. Further description is unnecessary. One point deserves mention, however. Opening the duodenum at the distal end of the tumor is an accident which easily happens. Great care should be exercised to avoid it but if it should occur no damage will result provided the opening is immediately closed with fine silk. The Fredet-Ramstedt operation properly done carries a low mortality and effects a complete cure.

The operation for duodenal obstruction is a more serious procedure and has a high mortality. Occasionally it is possible to relieve extrinsic obstruction by cutting a band or correcting a volvulus but usually a much more extensive operation is required. A diaphragm may be cut if that is the cause but in most instances it is necessary to perform a duodeno-jejunostomy. This is tremendously complicated by the contracted condition of the gut distal to the obstruction. Ladd[4] has reported several cases successfully treated by this method and recently Stetten[5] reported another in a premature infant.

Obstructions farther down in the small gut are treated by some form of entero-anastomosis. Sometimes the obstruction is the result of inspissated meconium in a stenotic portion of the gut, in which instance it is necessary to open the gut and remove the obstructing agent.

Atresia ani, next to pyloric stenosis, is the most common congenital alimentary tract obstruction. It is easily recognized by the fact that the baby does not pass meconium. According to Ladd and Gross[6] there are four types: two near the anus due to incomplete rupture of the anal membrane or to persistence of the anal membrane; and two higher up with the rectal pouch separated from it by considerable tissue. In one of the last forms the anal pouch is well formed and unless digital examination is made, the obstruction is not evident. X-ray examination not earlier than 36 hours after birth with the baby inverted will show the rectum filled with gas. If made earlier, or if the baby is not inverted, the gas will not be in the rectum. The anal sphincter is usually present.

In the treatment of these cases colostomy is to be avoided if possible. The rectal pouch is allowed to distend and then the operation is done from below. The sphincter is cut across by an antero-posterior incision and the dilated rectum mobilized by blunt dissection. It is then brought down, sutured to the sphincter and opened.

Congenital anomalies in this region are frequently associated with fistulous connections between rectum and genito-urinary tract but they do not produce obstruction and are mentioned here only in passing.

These congenital obstructions give symptoms early in life. Another obstruction arising later, but none the less peculiar to infancy, is intussusception. This is not a congenital defect, its etiology is obscure and the diagnosis is more often missed than in pyloric stenosis. Perhaps this is because the textbooks give a positive description that is not always present.

The textbooks describe a baby usually between 6 months and 2 years suddenly seized with severe abdominal pain and vomiting followed by shock and prostration. He passes a fecal stool followed by blood or blood and mucus and then the bowel is obstructed. On examination a sausage-shaped mass is felt in the abdomen and often by rectal examination. This description is essentially true but by the time the baby reaches the surgeon the picture may have changed.

In the majority of our cases the chief complaint was bloody stools and sometimes diarrhea. The history of vomiting and pain could be obtained from the parents but only by questioning, as these symptoms had ceased. Mass was felt in only about half as it was obscured by distention; and when it was felt by rectum the condition was advanced and most of the patients died. Instead of a child writhing in agony he appeared to be a healthy infant quietly sleeping. More than once I have had the anesthetist ask if the wrong patient had not been sent to the operating room. The decision to operate should be made on the history as well as on the present findings.

Preliminary treatment is of as much importance here as in pyloric stenosis but because of the danger of gangrene of the intussusceptum it must be hurried and the operation performed at the earliest safe moment without waiting for the maximum improvement. The administration of fluids can be continued during and after the operation.

The intussusception involves terminal ileum and cecum or colon in most of the cases. It is usually single but some we have seen were com-

pound, i.e., more than one intussusceptum was found in a single intussuscipiens. Gangrene of the bowel was present in about a third of our patients, all of whom died.

A right rectus incision is made regardless of where the mass is felt, as in practically all cases the intussusception starts on the right side and it is in this location that the greatest difficulty can be expected in reducing the intussusception. The reduction is made by milking out the intussusceptum rather than by traction which may rupture the delicate gut. In a few instances, however, a little careful traction may be a valuable assistance in the milking process but it should be done with the utmost gentleness and stopped at the first sign of resistance. An air enema, as practised by Farr,[7] given in the operating room with the abdomen open, may help to start the reduction or even accomplish it. This should be done only as a surgical procedure under direct vision because of the danger of rupturing the gut.

When gangrene is present, the surgeon has no choice but to resect the gangrenous gut although most resections result fatally. Infants and children tolerate ileostomy or colostomy so poorly that resection is the method of choice and there have been numerous successful resections reported. Dowd[8] reported one in a four year old boy in 1901 and another in a five day old baby in 1912.

Bleeding from the bowel may simulate intussusception when associated with gastrointestinal symptoms. Henoch's purpura is the principal disease to differentiate, but a bleeding Meckel's diverticulum may cause confusion, and bleeding by rectum in congenital syphilis obscured the diagnosis in one of our cases.

Strangulated hernia is another cause of intestinal obstruction. It is infrequent and when it occurs in childhood usually appears during the first two years of life. We have never had to resect the gut for this condition and in correcting the hernia simply ligate and remove the sac without attempting any sort of repair. A loop of gut twisted around an attached Meckel's diverticulum may also cause obstruction.

The inflammatory diseases of the abdomen in children may be divided into those without associated peritonitis and those with peritonitis. Obviously an inflammatory disturbance may start without peritonitis and develop it later but it will simplify matters to discuss them separately.

The condition for which early operation is imperative is acute appen-

dicitis. The typical syndrome of abdominal pain localizing in the right lower quadrant, followed by nausea and vomiting; tenderness over McBurney's point; fever and leukocytosis is known by every surgeon to be subject to variations. In childhood the symptom complex is even more variable and is easily confused with the onset of certain systemic diseases or with other abdominal inflammations.

The systemic diseases offer the least trouble although fully a third of the cases that are admitted to our service as acute appendicitis fall in the systemic group. The child is more prostrated, the temperature is higher, the abdominal pain is vague and the tenderness is indefinite and slight. Vague abdominal symptoms with a temperature above 103 seldom mean appendicitis and a little delay will serve either to clear up the symptoms entirely or to permit them to develop into those characteristic of the disease. Pneumonia, scarlet fever, tonsillitis and upper respiratory infections are the ones most often found.

Local retroperitoneal or intraäbdominal inflammatory conditions present more difficulties and it is often quite impossible to make the correct diagnosis without operation. Pyelitis, perinephric abscess or cystitis frequently simulate appendicitis and the urine examination, while usually sufficient to establish the diagnosis, may show nothing if the ureter is obstructed. In this connection it is well to remember that a low-lying acutely inflamed appendix may be close enough to the bladder to cause urinary symptoms.

Osteomyelitis of the ilium occurred in one of our patients and so closely resembled appendicitis that operation was performed. With the abdomen open the true nature of the trouble was manifest.

The pelvic inflammatory conditions of little girls are the easiest to differentiate. Salpingitis secondary to vaginitis and pelvic bleeding from rupture of an ovarian follicle or backflow secondary to an imperforate hymen are not particularly uncommon but rectal examination, examination of the vaginal smear and a consideration of the age of the patient will usually make the diagnosis.

Of the acute inflammatory conditions of the bowel, acute Meckel's diverticulitis and acute regional enteritis must be considered. A history of bleeding from the bowel may help with Meckel's diverticulitis but in any case operation is indicated and the diagnosis becomes of academic interest only. With acute regional enteritis the differential diagnosis is almost impossible and in all of our cases was made in the operating room.

They were treated by appendectomy and fortunately none went on to the chronic form of regional enteritis. Neither of these conditions is particularly common.

Mesenteric lymphadenitis is common, however, and is the worst stumbling block in differential diagnosis. In general the symptoms are a little less severe than those of appendicitis and the localization of pain and tenderness more or less indefinite. We usually make the diagnosis in the operating room, however, and remove the appendix as a routine procedure. We do not consider mesenteric lymphadenitis a clinical entity any more than lymphadenitis elsewhere in the body. I believe that it arises from the lymph drainage of infection or toxins in the area drained by the mesenteric nodes and is as protean as the area it drains and the infections thereof. For this reason I believe, contrary to Sobel and Stetten,[9] that removal of these nodes is fraught with danger. It has been done many times by many surgeons and neither culture nor pathological examination has shed any light on the situation; but I have seen three cases in which peritonitis followed removal of the nodes, in one of which death ensued and in another chronic invalidism after many enterostomies and laparotomies for obstruction. Being therefore useless and dangerous it is the perfect example of meddlesome surgery.

Of the inflammatory conditions noted, the treatment for appendicitis and Meckel's diverticulitis is operation; for the others, symptomatic. When the diagnosis of appendicitis is clear-cut there is little difficulty. This happens in only about half of the cases, however, so some other criteria must be established for surgery.

We place most importance on localized right lower quadrant tenderness, especially if the psoas sign is positive or if there is rebound tenderness. History is of next importance with pain and vomiting in their proper sequence. Fever and leukocytosis are of value when taken in conjunction with other evidence. A gangrenous appendix with little or no fever or leukocytosis is a common occurrence. Rectal examination should be done, but, except in older children, is of little value unless a mass is discovered. An adult finger in a child's rectum causes so much distress and active resentment that the examiner cannot tell whether the pain is due to the morbid process or the examining finger. When in doubt we consider that operation is the most conservative form of treatment. Furthermore, if a child gives a typical appendix history, even if abdominal signs are minimal, or if a child has more than one hospital admission

with the same indefinite abdominal symptoms, we operate. By following this course we make mistakes at times but we also find a great many acutely inflamed appendices which would otherwise have been missed; and we have never seen any harm arise from the unnecessary removal of the appendix under such circumstances.

Peritonitis is the most serious intraäbdominal condition and has the highest mortality. That secondary to a perforated appendix is the most common form. The disease starts with symptoms that can be recognized as due to appendicitis and too often there is a history of catharsis. Pain, vomiting, rigidity and distention make the diagnosis obvious. Unless the child is in a very serious condition, we operate, but only after the fluid and electrolyte balances have been restored. The appendix is removed, if that can be easily accomplished, otherwise the operation is terminated. If the condition is diffuse peritonitis we have been putting 4 to 6 grams of sulfanilamide into the peritoneum. Drainage is not practiced unless there is an abscess or unless it is not possible to remove the appendix. Only the peritoneum is closed, the remainder of the wound being left open and lightly packed with vaseline gauze. Our results have been highly gratifying.

Peritonitis associated with gonorrheal vaginitis is not uncommon, although with the use of sulfathiazole it is rapidly becoming so. It resembles primary peritonitis but a vaginal smear will readily disclose its true nature. Operation is not indicated. The gonorrheal peritonitis will subside rather quickly but, should the peritonitis prove to have another etiology, waiting for the abscess to develop may be the best form of therapy.

Primary peritonitis is practically always due to pneumococcus or streptococcus and many observers claim that it is almost entirely confined to girls. This they explain on the ground that entrance of the bacteria is gained via the genital tract and support their contention by the fact that cervical smear will produce the organism in pure culture. Our figures do not altogether support this contention even though there is a preponderance of girls. We agree with Newell[10] who divides primary peritonitis into three etiological groups, viz.: idiopathic; that associated with pulmonary or upper respiratory tract infections; and that associated with nephrosis.

The idiopathic type may predominate in girls but in others the female preponderance is slight. When peritonitis develops after an upper

respiratory infection it is usually a week or more after the onset and the sore throat or running ear is improving. Streptococcus is the organism usually responsible for this type. When associated with nephrosis the peritonitis is not necessarily a terminal condition as some of our patients have been able to form an abscess which can be drained and they have recovered. Pneumococcus is the usual organism in these instances.

The evidence is so typical of peritonitis that the diagnosis is rarely in doubt but as the treatment depends a great deal on the causative organism it is necessary to determine this. If the patient is a girl, cervical smear may give the desired information; otherwise abdominal puncture may be employed.

Our experience with abdominal puncture has not been altogether satisfactory in that sufficient fluid to give the information desired has not always been obtained. Also, the possibility of perforation of the gut with the needle makes the procedure not altogether harmless. Ladd, Botsford and Curnan[11] advocate making a small McBurney incision and opening the peritoneum under local anesthesia. If the peritonitis proves to be due to the colon bacillus, the incision can be enlarged and the appendix removed. If not, the pus can be sucked off and sulfanilamide inserted. This procedure has much to recommend it but we have had no personal experience with it.

Opinion differs as to treatment. Some of our patients recovered after drainage of acute peritonitis; others recovered after allowing an abscess to form and then draining that; but the majority of them died. Our feeling at present is to avoid operation in primary peritonitis until the formation of an abscess which is then drained. If the abdomen is opened under the mistaken diagnosis of secondary peritonitis, the pus is sucked off, sulfanilamide inserted and the peritoneum closed without drainage. The remainder of the wound is left open and packed with vaseline gauze. The proper chemotherapy is then begun by mouth.

Preliminary administration of glucose and saline by vein or hypodermoclysis is always advisable. No dehydrated child should ever be submitted to operation and the restoration of the normal fluid and electrolyte balances may mean the difference between recovery and death.

SUMMARY

Acute abdominal lesions of childhood are either obstructive or inflammatory.

The obstructive lesions occurring directly after birth are congenital; those occurring later are usually due to intussusception.

The inflammatory lesions are usually associated with the appendix but other conditions frequently obscure the diagnosis. Operation is the conservative treatment.

Primary peritonitis may occur, in which instance the conservative treatment is to delay operation until the formation of an abscess and then drain.

Restoration and maintenance of fluids and electrolytes is essential.

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